ENGINEERING SOC.
S.G.W.C.
FLUSH
bi-monthly pub.

Volume IV No. 8 February 28, 1962.

THE DORION TO ILE PERROT BRIDGE

The Province of Quebec has embarked on an energetic program of highway construction in the last year or so. The first phase of the work will be the building of the Trans-Canada Highway, followed by improvements to existing roads such as the Sherbrooke to Montreal, Montreal to Quebec via the north shore, etc. At the same time numerous highways and bridges which have been in use for many years and are strategically located must be re-examined, in the light of modern traffic, and either enlarged, repaired, or replaced. One very important structure in this catagory is the Dorion to Ile Perrot Bridge.

THE EXISTING BRIDGE - Superstructure

The existing bridge consists of a walkway four feet wide, a roadway 20 feet wide and a small curb about one and a half feet wide. The upper slab is of reinforced concrete and is supported by a series of floor beams spaced at five feet intervals spanning perpendicular to the direction of traffic. This system is then supported on two large steel plate girders which span in the direction of traffic from pier to pier. A typical cross-section is shown in Figure I. The entire bridge is 1395 feet long and consists of seven spans of 100'-9", eight spans of 70'-10½" and two of approximately 61'-0", i.e. sixteen piers and two abuttments.

The structure was erected in 1923 and is today 39 years old. In general, bridges of this type are expected to have a life expectancy of about 50 years. That is, we do not expect that the structure will suddenly collapse at this age, but it is anticipated that at this age serious repairs will be needed due to several factors, which can be stated briefly as follows:- The bridge is subjected to heavy moving loads. These loads set up vibrations which suddenly stress a member or connection to its maximum value and then the stress is reduced to that existing for dead load only. There are also stress reversals set up. These act to change the stress in some part of a member from say, tension at one instant to compression the next. The vibrations described give rise to a phenomena known as fatigue. Numerous investigations have shown that a bridge of this type reaches this state in about fifty years. This is estimated to a large extent on the number of vibrations and reversals of stress which have occurred. It has further been established that when a structure suffers from fatigue it may break up or change its shape even though no individual part has actually been overstressed. Other damage which a bridge of this age incurs is caused by rusting and subsequent seizing of the expansion joints and bearings. It is very difficult to make an estimate of this damage. Further, the use of salt on our roads in large quantities tends to destroy the concrete surface and cause serious corrosion especially in exposed steel above the roadway such as guard rails, lamp posts, drains, etc.

- Piers

A typical pier consists of a base and a vertical shaft as shown in Figure 2. About six of these are founded on rock and the remaining ones on gravel. The piers in the deep water were originally built by first constructing a wooden crib, or frame, bringing it out to the desired location in the river, sinking it and then pouring concrete into the crib, the concrete displacing the water as it filled up the crib. After the base was poured in this way, the shaft was poured later. No reinforcing steel was used.

- Loads

Since the time the bridge was constructed the weight and the volume of traffic has changed radically. For example, in 1923 a highway bridge was designed for a 20-ton truck which required a 9 foot lane. Today a highway bridge is designed for a 20-ton truck followed by a 16-ton trailer and requires a lane width of ten feet.

THE NEW BRIDGE

The Provincial Government decided to build a new bridge parallel to the existing and approximately 60 feet from it. The engineers were also asked to suggest some future, if any, for the old bridge after the new one is put up. Some of the possibilities were as follows:-

1) To build a new bridge beside the old and then to demolish the old one. This scheme has several disadvantages. The old bridge is situated in a very favourable location. It is of course impossible to demolish the existing structure, stop traffic for about nine months, and then start traffic again. A new structure would involve passing a road through the highly built up land, making expropriation costs exhorbitant, and delaying the work. Furthermore, to demolish a bridge of this type is much easier said than done. There are two railway bridges in the immediate vicinity which would make blasting impossible. The steel has no salvage value and it is against the law to allow any debris to fall into the river. All of these facts put together made this scheme practically impossible due to the costs involved.

2) It soon became self-evident that a new bridge must be located as close as possible to the old. This, therefore, involved pouring new piers directly beside the old ones and, in fact, joining them together. A gooddeal of the success of such an undertaking would depend on the condition of the existing piers and the bridge in general.

An extensive program was undertaken to investigate the condition of the existing piers and the soil conditions in the area where new piers will be located. This involved drilling shafts into the base and upper part of the piers, removing concrete cylinders of approximately 2 inches in diameter, and testing these for strength as well as the ability to resist freezing and thawing. The results from these tests revealed that the upper part of the piers were to a large extent in the same condition as when the bridge was built. In the lower part, i.e., that below water level or the base of the pier, it was discovered that the material consisted of large rocks poorly cemented together. It is unknown whether the base was originally constructed in this manner or whether over a period of years the cement was washed out or had deterioriated. In any case, this was not a good foundation and if the old piers were to be used this base would have to be consolidated first. It was decided after much deliberation that all factors taken together it would be possible to at least use the old piers. The following scheme was proposed for construction.

A coffer dam will be constructed to enclose about one third of the piers and the area where the new piers are to be constructed. The water (about 10 feet in depth) will be pumped out to render the entire area dry. The existing piers will be carefully examined below water level. Holes will be drilled into the interior of the base and especially prepared concrete will be pumped into the base, under high pressure, to consolidate the material. At the same time excavation will proceed beside the existing piers for the new base of the piers. Since most of the piers are not on solid rock there was some concern that if the new piers are joined immediately to the old the settlement that will later take place in the new part will cause serious cracking at the joint. To try and avoid this it is proposed to pour the new piers beside the old but to leave a gap between them. At the same time all the provisions will be made for pouring this gap closed at a later date, probably about one month or so after the new pier is completed. It is hoped that after this time most of the settlement would have taken place. After these set of piers are finished the coffer dam will be demolished and the material available will be used for the other sections. The work in the deep water will be done at low water level, probably around September or later.

THE SUPERSTRUCTURE

The most economical type of construction for a bridge of this type is to use composite construction. This involves designing the top concrete slab to act together with the steel girders. This is accomplished by welding anchors, called studs, to the top flange of the girder and then pouring the concrete slab to include the top flange. At first the steel girders support the concrete dead weight since the concrete is plastic and has no strength. After a month or so when the concrete hardens it begins to act as one beam with the steel and the subsequent live loads that come on the structure are resisted by the concrete and steel acting together as one beam.

In this bridge it was decided to use four girders spaced at 8'-9" apart spanning from pier to pier.

Expansion Joints

Due to the variations in temperature to which an outside structure is subjected, it is very important to provide each span with adequate room for expansion and contraction. Fundamentally this involves fixing one end of the span and setting the other end on a movable roller. The simplest means of providing movement at a pier is to allow the steel to slide over plates usually highly polished bronze. Another way of accomplishing the same thing is to provide a nest of rollers over which the end of the girder can move freely. In our case both of these methods were inadequate. Since most of the piers were on soil a small horizontal force at the top of the pier would create a large soil pressure at the foundation. It was, therefore, essential to design an expansion joint which exerts no horizontal force when motion takes place. In the case of a sliding joint, say steel on bronze, the friction force is too large. Although rollers have been used successfully in the past, experience has shown that after several years the moving parts rust and tend to seize. A rocker was designed to avoid both of these troubles. The principal here was to use a wheel rolling. The friction is rolling friction and the coefficient is very small. To keep these rockers as small as possible they will be made of high strength steel called Cor-Ten which has good rust resisting properties. From Figure No. 3 it is clear that there is no change of jamming in such a rocker regardless of age.

Guard Rails

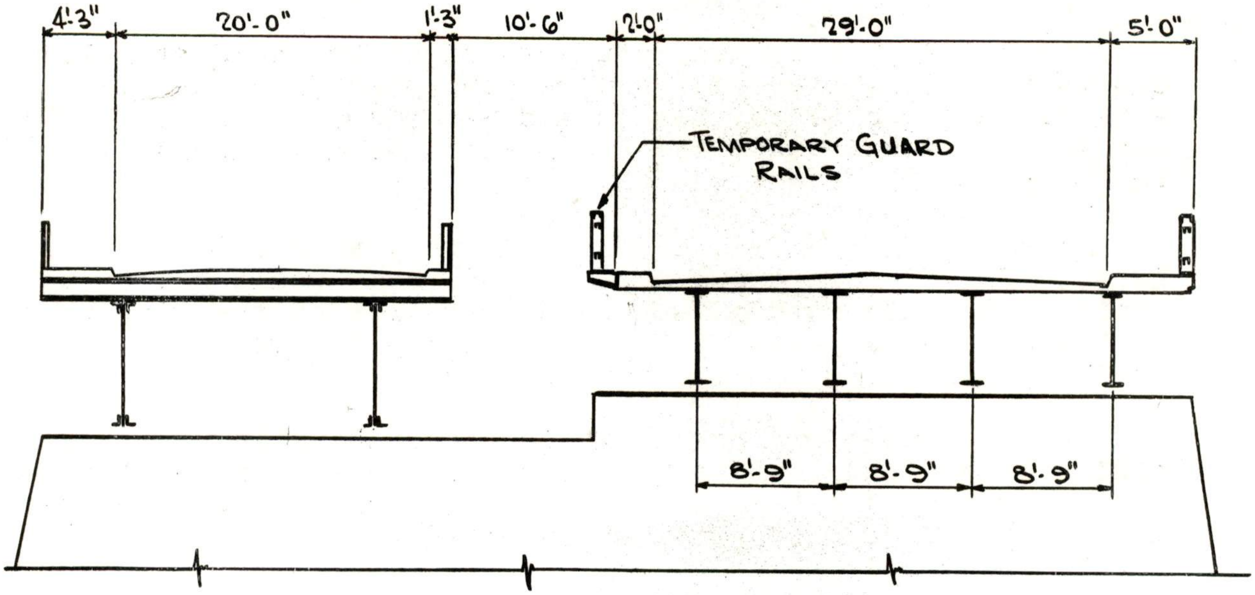
The guard rails are standard, used on most bridges aroung Montreal and can, therefore, be easily replaced. Of interest only is the fact that all the rails on the north side of the bridge will be temporary and removed after the second stage is completed.

The second stage

After the new bridge is built it is proposed to divert traffic on to it, close the old bridge and start work on the old one. It is already known that the deck, floor beams, and guard rails are of no value and will be removed. The only part which may be of some value is the steel girders. It is not clear as yet as to what means will be used to investigate their condition but it is apparent that they would have to be separated and reinforced with new girders between the old. Most likely they will be removed and a new superstructure erected to look like the one just finished and to have the same life expectancy.

The first stage of the work is scheduled to start this spring.

G. Goldman, M. Eng., P. Eng.



EXISTING BRIDGE

NEW PROPOSED STRUCTURE

FIG. NO. 1 CROSS-SECTION

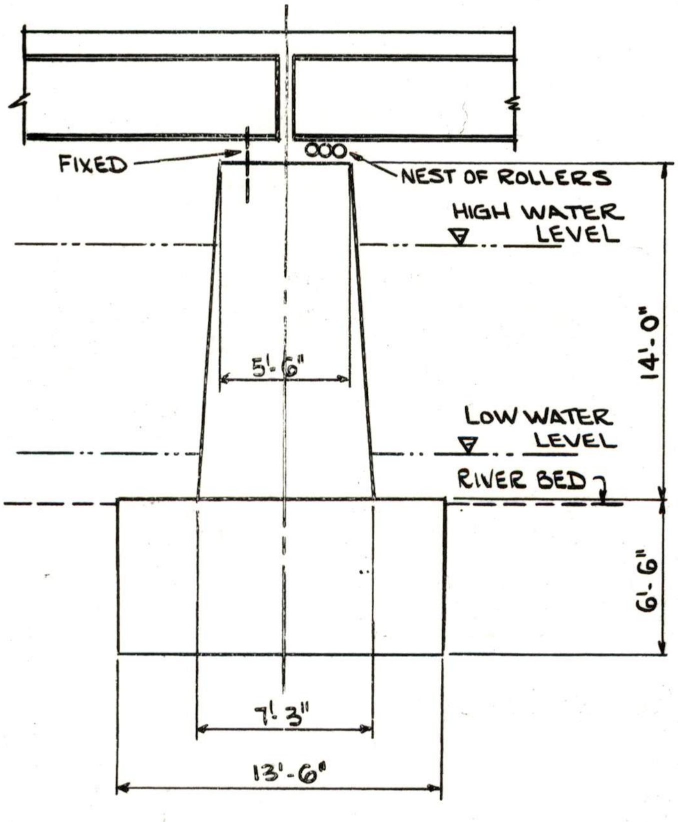


FIG. NO. 2 TYPICAL EXISTING PIER

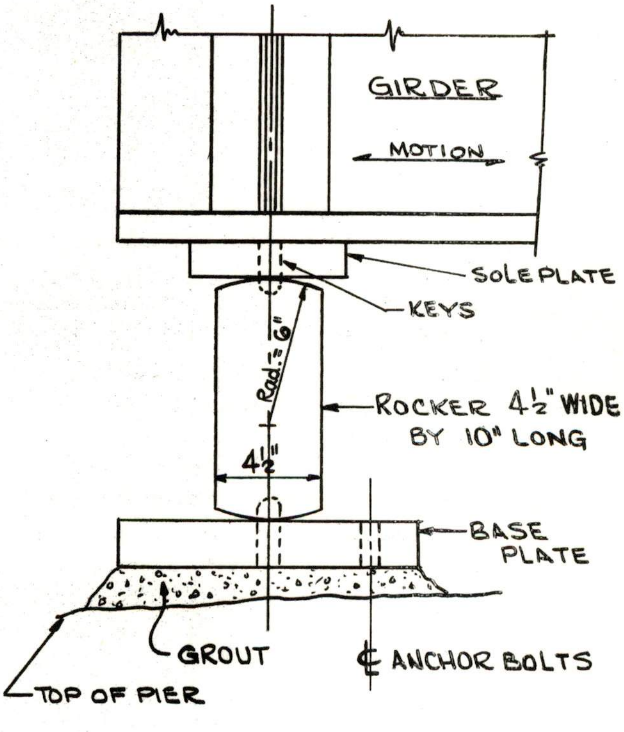


FIG. NO. 3 ROCKER AT MOVING END

E. I. C. NIGHT

On Friday, Feb. 16th, students night was held at E.I.C. headquarters. Six summer essays were presented from Laval, Sherbrooke, McGill, Polythechnique, Loyola and Sir George. As usual, Sir George was well presented both by students and Faculty members, to support their man Derek Bright who spoke on studs.

The competition was won by a fifth year civil engineer from Laval. Had it been known before hand, many would have brushed on their French and perhaps would have understood the winning presentation which was given in French. In the future, the sponsors of student night hope to have more bilingual speaches.

As announced, refreshments were served while the judges were deciding on a winner. After the meeting was adjourned, the Georgian Engineers once again kept the flow constant and even though their man didn't win first prize, they proved their great thirst........ for knowledge.(?)

For some the meeting ended at E.I.C.; but others took advantage of the evening and from all rumours, they made a very careful study of the popular twist.

Steve Coffin & Hank Sydor

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HAVE YOU HEARD ABOUT THE LITTLE MORON WHO..........

- Ran across the top of the corn flakes box, because it said; 'Tear around here".
- Took the street-car home, but his mother made hime take it back.
- Went to the lumber yard to find the Board of Education.
- Went into the living room because he thought he was dying.
- Made three socks for her son because someone said she heard he had grown another foot.
- Saluted the refrigerator because someone said it was General Electric.
- Took hay to bed to feed his night mare.
- Backed off the bus to keep a lady from pinching his seat.
- Cut off his arms so he could wear a sleeveless sweater.
- Drank 8 cokes and belched 7 up.

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COMING MOVIES

Feb. 28	West Coast Cargo Colour (C.I.L.)	Room: 327
Mar. 7	The Open Road (Bethlehem Steel)	Room: 327
Mar.14	Packaged Power Power for Progress(Alcan)	Room: 327

KEEPING THE FLOW CONSTANT

A snuff manufacturer is a fellow who goes around putting his business in other people's noses.

"But, mama, I'm not hungry. I ate all the raisins off the flypaper."

Once there was a girl named Virginia. They called her Virgin for short, but not for long.

The telephone rang, and the travelling salesman answered it. "What? How would I know? Call the Weather Bureau!"
"Who was that?" asked his wife.
"Oh, I dunno - some damnfool wanting to know if the coast was clear."

Said the nanny to the billy goat: "You can go as far as you want to, tall, dark and stinky - just don't kid me."

He (after a long embrace) "Clara, you must get those cavities filled."

DOWN THE DRAIN

You may hear it differently but Bert Martin's wife beat him up when he came home stoned after the E.I.C. night. Isn't that right Bert.
- Prof. Goldman's mechanics assignments may keep the boys up all night, but at least, according to him, it keeps them out of the wrong beds!!
- Paul Ratki is now organizing a new society. It is called the "Society for the.........(S.S.O.V.). All inquiries should be addressed to Roy Bourke, who is Secretary of the Society.
- Many are wondering what Prof. Vowles finds so interesting in the top left hand corner of her lecture rooms. Anybody know why?
- At the end of the term session in 1428, Earl Hewitt and Don Driscoll had to be rolled out. But Barry Beauchamp was talking somewhat wildly about quitting school to buy (?) a tavern?
- Gerry Descoteaux has been acclaimed the best dressed ex-engineer with his white collar, dark suit, yellow cuff-links and an oversized pipe. He looks like a rising business executive?
- Prof. Igbal's new discipline policy has started off with a bang!! He's already kicked out two unfortunate and innocent bysitters.
- Those who attended students night at E.I.C. noticed the tremendous popularity of the bow-ties. Later on, one could also see the unholy spectacle of the students smoking distinctive, odoriferous 2½¢ cigars.
- Bert Martin refused to make a study of the popular twist after E.I.C. night. When asked why, he replied: "Shthe booze ish free here, shat's why I'm shtaying."
- Barry Beauchamp is really a drinker now. At E.I.C., he couldn't even stop long enough to chat and light his cigarettes.
- Derek Bright was seen on St. Catherine riding a sleigh with his separatist friends(?)
- Ian Robertson must have been bad off. He was laying on St. Catherine after E.I.C. night.